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Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

No. 105

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WORLDWIDE REPORT

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

No. 105

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MATRA SPACE TELECOM CHIEF MIGNOT INTERVIEWED

Paris AVIATION MAGAZINE INTERNATIONAL in French 1-14 Dec 79 p 15

[Interview with Noel Mignot, director of Matra's "space" branch: "Telecom 1, a French Product, Must Also Be Tied to European Interests"--date and place not given]

[Text] [Question] "Ariane" should allow us to sell "immediate delivery" systems. This means that the market for utilitarian satellites is not going to be broken into in the same way as it was when they were launched by the Americans. How then are you going to break into this market?

[Answer] "Ariane" represents an indispensable step toward our selling whatever satellite involved. I will simply say that, without the success of "Ariane" the whole future of our space industry will be doubtful.

Then as for knowing how the existence of "Ariane" will influence the type of contracts which we will be induced to propose, particularly for exportation, I believe that we will be induced to make them "to order." That is why some lines can be foreseen by simply observing what is happening in the United States. The market is evolving more and more towards sales by leasing and even to the extreme of sales of services; whence the necessity, over and above products like the satellite and the launcher, of taking some assemblies into consideration, while also including the important questions of financing and insurances.

[Question] You have assured us that "Telecom" 1 will be exported. Which markets are foreseen to be the first?

[Answer] In fact we haven't waited to make ourselves available to exportation. In early January we are going to submit our proposals in response to Arabsat's call for bids. We now have a major marketing plan. Our efforts are already taking effect in some South American countries and in French speaking Africa. On the other hand, in liaison with BA [British Aerospace] and Thomson, we are going to work on the satellite problems peculiar to Australia. These are the markets which seem the most fruitful. However, the difficult with trade indeed remains guessing which call for bids will result in contracts and which will result in only a simple consultation.

[Question] The creation of Ariane-Space shows that traditionally styled structures such as CNES [National Center for Space Studies] and ESA [European Space Agency] do not seem to be suited to a commercial approach to the market. What do you think about it, and can one foresee some commercial structures for each category "Telecom" 1, terrestrial resources satellites?

[Answer] First I would recall that in commercial matters, the real problem is financing. It is obvious that organizations of this type work with annual budgets which do not allow them to take risks. They can only pursue business which has been the result of a "decision" or of a vote. To export you must begin manufacturing, at least stocking some of the main parts, that is, the elements that take the most time, to have a delivery time compatible with the needs of the market. Budgetary administrative processes won't allow this type of action, which carries an industrial risk.

It is this type of problem that is particularly facing our industrialists. For the chance for successful exportation obviously lies in disposal of a reasonable number of identical products. An example: with BA we have received an order for 11 ECS satellites of the same kind, and only now can we begin to lower the price, like the good American manufacturers are able to do.

However, as for so-called structures, I would say that they must find their basis through several solutions, bearing as much on the purely technical as on the commercial plane. On our part, with MESH or with BA in particular, we are trying to find some answers to solve the problems of industrial risk. For we do not wish to solidify the plans for structures whose ultimate objectives are poorly defined. In fact, it is the necessity to do a ertain number of things together which gives rise to the creation of structures, and not the inverse.

[Question] What will be the logical development of "Telecom" 1 on the French and European planes?

[Answer] On the French plane, P & T [Postal and Telecommunications Administration] is planning to make an operational satellite, and it seems probable that the first experimentation will allow us to better define the clientele, particularly in telematics, and to in time produce models more and more adapted to the market. "Telecom" 1 being an extremely new product in relation to its market, changes must be expected. But in any case, definition of new models remains in the hands of P & T.

As for Europe, by getting a telematic service underway for the first time on the old continent, P & T certainly has affirmed its intention of rallying the other countries of the community to this same type

of service. The objective is to achieve within Europe a greater cohesion, with the help of common standards. So it is important that France had played a pioneer role in this affair; because for the industrialists, it is an opportunity to obtain a good position on the market.

However, although "Telecom" 1 is a French product, it is necessary from now on to tie this product to the interests of the industrialists and administrations of the other countries in the community.

[Question] And on a worldwide scale?

[Answer] That's another question. There are two aspects to exportation; the sale of satellites and the sale of ground equipment, two markets which are governed by extremely different rules.

For satellites, one especially thinks of already far advanced countries like Brazil, Argentina, Mexico, the Near East states, Australia, etc. However, probably the basic vehicles destined for these markets would be rather telephone or television satellites; links between computers, for example, not yet representing a significant market within these countries, and "Telecom" 1 being oriented toward telematics. As for American markets, they remain very closed, except for a certain number of very specialized elements and equipment.

On the other hand, in the area of ground equipment developed for "Telecom" 1, the U.S. market appears to be the most open. There are three reasons; a service such as telematic can interest only rich and developed countries, it is not a sovereignty market like that of satellites, and finally, French industries remain in a better position in this field in relation to the Americans.

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DOMESTIC SATELLITE SYSTEM DISCUSSED, FIRST STEPS TAKEN

Telecom Involvement Discussed

Sydney THE SYDNEY MORNING HERALD in English 5 Nov 79 p 9

[Text]

PERTH. — Telecom should lose exclusive Australian communications rights if it continued to show reluctance to develop a satellite communications system, according to the Federal Government's top satellite authority.

Mr Harold White, the chairman of the Government inquiry set up in 1977 to examine the need for a domestic satellite, said private enterprise would be eager to take over the job from Telecom.

He told the annual Northern Australian Development Seminar in Broome at the weekend that development of the satellite system needed to begin immediately.

Best estimates were that the system could be operating to the advantage of all Australians by 1985.

But Telecom appeared to be reluctant to move into the planning stage, even though the system had been approved last month by Federal Cabinet.

Delays would be unthinkable, Mr White said. "Plans should be prepared and tenders called to equip Australia with communications for the space age."

He told the seminar that all Australians should have a first-class 24-hour automatic telephone service and access to a variety of radio and television stations.

Mr White is general manager of the Overseas Telecommunications Commission.

The inquiry he claimed recommended that a satellite communications system be established. It was tabled in Federal Parliament in September last year.

The Federal Government announced last month that a $210 million satellite system would be established.

CANBERRA. — No one would have a monopoly over Australia's domestic communications satellite system, the Minister for Post and Telecommunications, Mr Staley, said yesterday.

He said the Federal Government was absolutely committed to the maintenance and strengthening of regional television services.

Mr Staley was broadcasting to the Prime Minister's electorate of Wannon on behalf of Mr Fraser, who is ill.

He spoke on the decision to go ahead with the satellite system at an estimated cost of $210 million.

He said that in establishing the system, probably by the end of 1984, there would be maximum involvement by Australian industry.

"We already know the varying capability of Australian industry in communications and related electronics fields," he said.

"The Government will not sign any agreement for the supply of a satellite system that does not provide adequate safeguards for Australian participation."

Mr Staley said it was hoped that local industry could supply much of the $75 million earth facilities for the project.

"Local industry will also play a predominant role in installation, testing, operation and maintenance of the entire range of ground equipment needed in a satellite system."

He defended the cost of the project and said that, of the $210 million, the net outlay by the Government would be about $42 million.

Satellite Television Tests

Canberra THE AUSTRALIAN in English 15 Nov 79 p 5

[Report from Doug Holden]

[Text] TESTS beginning this weekend will determine whether the cyclonic weather in northern Queensland will prevent satellite television transmissions.

The Minister for Post and Telecommuniations, Mr Staley, said yesterday that heavy rain could interfere with television signals transmitted by satellite.

The tests, using the Canadian Hermes satellite, which orbits over the north-eastern Pacific, will determine whether the wet season will prevent acceptable reception.

The tests will be made over two months at several homes in the Cooktown area.

"We want to make sure we do not look at any kind of system or equipment which is not able to cope with some of the more extreme conditions experienced by remote area dwellers," he said.

Heavy rain creates interference by causing loss of strength in satellite broadcast signals.

The experiments will judge how acceptable different levels of interference are to viewers, and will enable measurement of interference levels under different rainfall densities at a number of locations.

"They epitomise the Government's determination to ensure rigorous evaluation of every possible technical, operational and financial aspect of satellite system options before final decisions are taken on a system best able to meet Australia's national requirements," Mr Staley said.

Government Invites Bids

Perth THE WEST AUSTRALIAN in English 17 Nov 79 p 22

[Text] CANBERRA: A major step in sending up Australia's first communication satellite system was taken yesterday.

The Federal Government advertised nationally an invitation to register interest in the $210 million project, announced four weeks ago.

The Post and Telecommunications Minister, Mr Staley, said that the attention of overseas interests would be drawn to the advertisements through appropriate channels.

The satellite system, expected to be launched by space shuttle in 1984, would provide:

- Radio and television broadcasting — fixed or relay services within and between Australian States—and direct broadcasting services to individual homes in remote areas and areas of poor reception.
- Voice and data services for a range of users including Federal government bodies such as the Departments of Transport, Science and the Environment, Health and Education.
- Telephone services for major trunk traffic and people and communities in remote areas, linking them into the national telephone network.

"The provision of telecommunications services to Australian off-shore territories is also being considered," Mr Staley said.

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TELECOM PLANNING GROUND NETWORK DESPITE SATELLITE

Canberra THE AUSTRALIAN in English 22 Oct 79 p 14

[Text]

DESPITE the announcement last week of a domestic communications satellite, Telecom Australia will press ahead with a series of terrestial programs to bring automated telephone services to to people in remote areas.

A telecom spokesman said on Friday that system definition was the next critical step in the satellite program and that Telecom "stood ready" to participate with its background of technical expertise.

Telecom made it clear to the original White committe which first studied the domestic satellite proposal that it was not convinced of the economics of the proposal and that it believed the terrestial systems which it had under development could provide services at less cost.

However, it told the committee that if there was to be a satellite system, it believed Telecom should run it.

A spokesman said on Friday: "The Government has now made a decision and the thing is to get the best possible satellite."

The Minister for Post and Telecommunications, Mr Staley, mentioned in his announcement of the system a figure of 40 000 people without telephones.

Telecom was uncertain of the origin of this figure and whether it might include people with no desire or little requirement for a telephone service, such as nomadic Aborigninees.

It recently commissioned a study by a Sydney-based firm for about $100 000 to define by May next year what are the real needs — now and projected — of remote aboriginal communities, individual pastoralists, mines and other people in the Northern Territory.

This will later be applied to the rest of Australia in an attempt to define what communications services are really needed in remote areas.

Telecom believes it will have broken the back of the rural communications problem by 1985 when it will have reduced the number of non-automatic exchange services in Australia to less than 10,000.

The Government recently announced that Telecom could undertake an extra loans program to accelerate its rural phones program to reduce the number of subscribers — currently about 90,000, including some still on party lines — now connected to non-automatic services.

About 10-12,000 new subscribers are expected to be added to the system as automatic services are installed.

The rural automation program is expected to cost about $500 million by 1985.

This will still leave a residue of very remote subscribers, or people requiring phone services, and the Telecom spokesman admitted that for these people, a satellite system could be the only answer.

But Telecom is also developing in its research laboratories a digital radio concentrator system which would beam telephone messages by radio over an area of about 150 km by 60 km.

Telecom is hoping it may be able to start installing these systems in three to four years, to pick up extra services in very remote areas. The system would be applied to the common geographical pattern in remote areas where a series of properties tended to follow the line of a river and a series of these systems could be installed along a swathe of properties.

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TELECOM, UNION NEAR AGREEMENT ON NEW TECHNOLOGY

Melbourne THE AGE in English 2 Nov 79 p 3

[Report from Michael Doyle, Industrial Reporter]

[Text]

Australia's largest employer, Telecom, is set to approve a landmark agreement on new technology affecting up to 87,000 workers.

Twenty-five of the 27 Telecom unions are believed to have supported the draft agreement, which has been thrashed out after two years' negotiations.

The two largest Telecom unions, the Australian Telecommunications Employees' Association and the Australian Postal and Telecommunications' Union, seem certain to ratify it soon.

Officials of the 26,000-member ATEA — the largest union operating solely within Telecom — claim privately that the draft is a watershed in Australia and compares favorably with any foreign technology agreement.

The three-year agreement features a commitment from Telecom to create "productive and economic" jobs within and outside its own organisation to offset jobs displaced by automation.

It also gives unions a generous say in the introduction of technological change, although management retains the rights to decide the type of equipment purchased.

If ratified, the agreement is likely to act as a pacesetter for future technology deals between unions and employers.

The only apparent failure in the agreement is on retrenchment and redeployment. The unions wanted no retrenchments as a result of automation, while Telecom said there would be retrenchments only "where there is no alternative nearby job in Telecom and jobs in the nearest available location".

Telecom offered special assistance regarding notice, training, and income maintenance for redeployed and retrenched workers.

The agreement is expected to be completed in the next three months. Both the ATEA and APTU will decide their policies before the end of the year and the Telecom commissioners will meet soon after.

A subcommittee of management and unions will then work out further details of the agreement.

The commissioners have already welcomed it as a constructive step but have reserved their decision.

Another highlight of the agreement is the principle that benefits of technology should be shared between customers, the community, and staff.

This opens the way for subscriber charges to be lowered — or increases to be restricted — and for improvement in the pay and conditions of Telecom staff.

The agreement also provides that:

Automation should be introduced only if there is a "demonstrable net benefit" to the public.

Telecom must inform unions of the reasons for technological change as soon as possible.

- Telecom must enter a feasibility study with the unions on any proposed change.
- The study includes detail on the type of equipment, its impact on staff and the public, and its economic effects.
- The unions can oppose the new technology even after taking part in the studies.
- Union views will be heeded on specifications for equipment.
- Tender documents will be available to the unions.

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BRIEFS

IMPROVEMENTS IN WEST AUSTRALIA--Telecom is planning to spend more than $10 million improving communications in the Kimberleys. It will extend its broadband system from Port Hedland to Broome and Derby and later to Wyndham and Kununurra. Details of the construction of about 18 microwave relay towers have not been finalised but, according to a Telecom spokesman, the Port Hedland to Derby extension is expected to be operating by 1982-83. The spokesman said that it was expected that extensions beyond Derby would follow the Port Hedland-Derby work. He said that the development of mineral, oil and gas operations in the West was being monitored by Telecom and solar power could play an important part in the Kimberley project. WA had been using sun to power telecommunications in remote areas since 1976. There were 15 solar-powered installations and almost 300 services powered by the sun. These ranged from small units powering country exchanges and radio systems to big arrays which powered repeater stations on outback trunk routes. The investment in solar power in the West would climb to almost $380,000 this year, the spokesman said. [Excerpts] [Perth THE WEST AUSTRALIAN in English 30 Oct 79, Supp., p 1]

NEW LOW-COST TRANSMITTER--National Semiconductor Corp. has developed a unique low cost transmitter/receiver IC pair. It not only allows for the design of light weight and compact control systems, for low cost applications like remote control toys, but increases reliability and performance as well. The LM1871 and LM1872 monolithic ICs make use of an innovative and unusual pulse code modulation technique that allows the chip set to handle both analog and digital control signal information. According to Chris Mason, applications engineer at NS Electronics, Sydney, the LM1871/1872 chip set is easily adaptable to numerous applications requiring remote transfer of analog and/or digital information, ranging in complexity from simple toys to sophisticated units with several channels of proportional analog control. Together the LM1871/1872 provide the R/C system designer with a wide range of features. They include two analog channels for proportional control; two channels of digital control

for either/or control; operation in the 27MHz and 49MHz unlicensed bands or in the 72MHz band; 50m outdoor control range; regulated transmitter RF output; and a receiver analog output compatible with standard servo designs. Fabricated using high performance linear processing, the LM1871 transmitter/encoder IC contains all of the active circuitry to decode potentiometer positions and switch states into a pulse modulated RF output. It also contains an internal voltage regulator which keeps radiated power constant even if the supply voltage changes. [Excerpts] [Canberra THE AUSTRALIAN in English 5 Nov 79 p 12]

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BRIEFS

PHOTOCONDUCTIVE COMMUNICATIONS SYMPOSIUM--Wuhan, 8 Dec--China's first symposium on photoconductive fiber communications [guang dao xian wei tong xin 0342 1418 4960 4850 6639 0207] declared that China has achieved gratifying success in the study of photoconductive communications. Representatives attending the meeting, which was ended in Wuhan following a 6-day session, visited an experimental photoconductive communications system installed at the Wuhan Institute of Postal and Telegraphic Sciences. The system is capable of transmitting messages 5.7 kilometers through glass fibers that transmit light waves. A system that can transmit messages 1.8 kilometers has been installed in Shanghai, and another system, that can transmit messages 3.3 kilometers has been installed in Beijing. All the equipment used in the three cities is made domestically. The symposium received over 100 academic reports submitted by the 200 or so representatives who came from various parts of China. [OW141822 Beijing XINHUA Domestic Service in Chinese 0734 GMT 8 Dec 79 OW]

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BRIEFS

TAIPEI-PRETORIA TELECOMMUNICATIONS--Taipei, 6 Dec (CNA)--Direct telegram and telex communications between Taipei and Pretoria, capital of the Republic of South Africa, was inaugurated Wednesday, a spokesman of the International Telecommunication Administration of the Republic of China said. He said direct telephone communication between the two cities is expected to open in mid-1980. [Text] [OW060519 Taipei CNA in English 0330 GMT 6 Dec 79 OW]

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BRIEFS

NEW TELEVISION TRANSMITTER--A new television transmitter has been put into operation in Olomouc-Radikov, in a ceremony in the presence of J. Janousek, director of the Prague Radiocommunications Administration [no date given]. Polish and Hungarian specialists took part in its construction. [AU111406 Prague ZEMEDELSKE NOVINY in Czech 9 Jan 80 p 6 AU]

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BRAZIL

BRIEFS

NEW TELEVISION, RADIO STATIONS--President Figueiredo has signed two decrees authorizing the establishment of television station "TV Record de Jau S.A." in the city of Jau, state of Sao Paulo and the radio station "Radio Nova Sumare Ltda" in Sumare, also in the state of Sao Paulo. [PY181119 Rio de Janeiro O GLOBO in Portuguese 11 Jan 80 p 6 PY]

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BRIEFS

JAPANESE CONTRACT--Dainichi Nippon Cable Co of Japan has won a contract worth $21 million to replace all existing overhead telephone and telex lines in Amman and install a total of 40,000 new lines, it was announced last week. The contract, due for completion within 30 months, is being financed through, a loan from Japan's Export-Import Bank, repayable over 8 years with 3 years' grace at an annual rate of 8 percent. The overhead lines will be replaced by underground jellyfilled cables. The contract also includes extending telephone and telex services into various parts of the city and linking the automatic telephone exchange system in central Amman with new exchanges due to enter service over the next three years in suburban and residential districts. [Text] [Paris AN-NAHAR ARAB REPORT & MEMO in English 17 Dec 79 p 15]

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AFRICAN DATA PROCESSING CONFERENCE OPENS IN IVORY COAST

Regional Cooperation

Abidjan FRATERNITE-MATIN in French 22 Nov 79 p 3

[Article by S. O'Kellas Kane]

[Text] The conference for integration in the data processing field will be held in the meeting hall of the Hotel Ivoire starting this morning at 1030 hours and continuing until 30 November. The conference is under the sponsorship of the Central Office of Data Processing (OCM) and the Intergovernmental Bureau for Data Processing (IBI).

This vast topic will be considered from three very distinct standpoints: the perspectives for new data processing techniques, transnational interchanges of information and the organization of a working group responsible for promoting regional cooperation in the data processing field.

In fact, this conference, which is being chaired by the minister of economy, finance and planning, Abdoulaye Kone, will have the participation of about 150 delegates from French-speaking and English-speaking Black Africa, the Maghreb, Latin America and Europe (51 states will be represented) in addition to experts from international organizations such as the OAU, UDAC [expansion unknown], UPAT [expansion unknown], CEAO, ECOWAS [Economic Community of West African States], ADB [African Development Bank] and the Economic Commission for Africa.

Many papers are on the agenda. In addition to the eagerly awaited participation of experts in this field, namely Simon Nora, Bruno Lusatho, Theys, Dominique Warnier, Pipe and France Lanord, papers will be presented by other delegates. Thus Zaire will give a report on the ERTS [Earth Resources Technology Satellite], Cameroon on data processing in the customs sector and our country will present a report on its experience in the computerization of airline companies (Air-Afrique and UTA [Air Transportation Union], interbank exchanges in Africa, computerization of the National Archives and, finally, computerized telecommunications.

The penetration of data processing into the African market is now a fait accompli, and the marriage of data processing and telecommunications which produced telemetry has become a reality. Unquestionably this union will shake up tomorrow's world. That means this conference on the integration of African data processing is being held at an opportune time. And no one doubts--at least we have reason to believe--that at the end of the meeting we will have a good idea of the different possibilities offered by new techniques in the computer field and the advantages of regional cooperation in this sector.

Let us remember that the IBI, which is the cosponsor of this conference with our Central Office of Data Processing headed by Oumar Toure, is an autonomous organization established in 1961 by the United Nations and UNESCO. It is the only intergovernmental organization specializing in data processing.

Opening Session Reviewed

Abidjan FRATERNITE-MATIN in French 23 Nov 79 pp 4-5

[Article by S. O'Kellas Kane]

[Text] The opening session of the conference on the integration of African data processing was held yesterday morning in the meeting hall of the Hotel Ivoire, under the chairmanship of the grand chancellor of the National Order, Germain Coffi Gadeau, representing the chief of state and president of the Council of Administration of the Office of Data Processing.

The first speaker at the opening ceremony was the minister of Economy, Finance and Planning, Abdoulaye Kone, whose succinct presentation gave a veritable panorama of the data processing field, in Africa and the world. He emphasized the importance of such a conference for our continent. "Your presence here, honorable delegates," Minister Kone said, "means in fact that Africa is not being left out of this considerable change in the modern world which involves the fantastic development of the data processing field and is called upon to directly participate in the development of this necessary data processing organization at the world level, to which the Intergovernmental Bureau for Data Processing is committed."

"Contrary to a generally widespread opinion," the minister continued, "our states quickly recognized at the time they became independent the advantages they could derive from data processing. What is more there was a remarkable simultaneity in the 1960's between the emergency of our young nations and the expansion of the data processing sector. The Ivory Coast is pleased that in 1962 it was the first state of Black Africa to obtain a computer for the management of public finances. Most of the French-speaking African states followed its lead. In the period of 7 years, all of our finances were being managed by computer in an integrated system

which did not have to take second place to any similar system in the industrialized countries."

Then the minister of Economy, Finance and Planning, Abdoulaye Kone, a well-informed man, spent considerable time on the development of automatic processing of information during the 1970s. He underscored the fact that Africa, although touched by this technological evolution, remains typically underdeveloped in the data processing equipment sector. In fact, it is true that of the 150,000 computers installed in the world in 1967, with a per unit worth in excess of 20 million of our francs, only 1,800 machines, of which South Africa had 60 percent, were to be found on our continent. In the United States there are 285 computers per 1 million inhabitants, compared to the 130 in Europe, 40 in the countries of the East, 10 in Latin America; there are only two machines per million inhabitants in Africa.

As for the short term future, we are permitted to have hope, if the minister is correct, with the appearance of microprocessors. "The almost unlimited increase in small machines," he emphasized, "and the decentralization of data processing networks, therefore, gives developing countries immense possibilities but possibilities which rest upon a technology which is out of reach for them. This poses a threat of domination and alienation, underscored by all those who have concerned themselves with the data processing problems of society.

The Data Processing Revolution

Speaking next, the director general of the Intergovernmental Bureau for Data Processing, Prof Firmin A. Bernasconi, emphasized in substance: "Big problems are not resolved by palliatives. They call for big remedies. We are firmly convinced that data processing, without being a panacea, has a prominent role in the spectrum of remedies for our problems of the moment. That is true for all countries, in different ways.... For the developing country, data processing is an opportunity which should be firmly grasped."

The speaker also emphasized the role of the Intergovernmental Bureau for Data Processing and the objectives pursued. In our upcoming editions, we will come back to this organization established by the United Nations and UNESCO to promote data processing.

Professor Bernasconi also spoke of the three objectives of the Abidjan conference: the perspectives for new data processing techniques, transnational interchanges of information and the organization of an African working group, after which he emphasized: "Today's problems are the consequences of yesterdays errors, and present successes are the logical result of judicious decisions made in the past... Today's underdeveloped countries are those which yesterday missed the train of the industrial revolution, and the underdeveloped countries of tomorrow will perhaps be those which now hesitate to get aboard the train of the data processing revolution."

Before declaring the conference for the integration of African data processing open, the grand chancellor, Germain Coffi Gadeau, gave a historical account of data processing in our country, after having welcomed the member delegates from Africa, Europe, Latin America and international organizations.

"Our young nations," the Grand Chancellor said, "not only need raw materials and energy; they also have need of access to this new source of power, namely data processing... Unlike the industrial revolution, this data processing revolution is both a powerful agent for the reduction of development differences between nations and a unification factor between nations."

Yesterday afternoon was devoted to the formation of committees and approval of the agenda.

Transnational Aspects of Data Processing

Abidjan FRANTERNITE-MATIN in French 27 Nov p 3

[Article by S. O'Kellas Kane]

[Text] After a trip to Assoinde during the weekend, participants in the conference for the integration of African data processing being held in our country since 22 November 1979 resumed their work yesterday morning in committee.

Debates were held on various aspects of point six on the agenda, namely policies on transnational communications experienced their real development in the 1970's and this thanks to considerable technological progress.

Machines used to handle data have not only experienced increased capacities and profitability but have also become faster.

Paralleling the increase in terminals on the one hand and improvement in telecommunications services on the other, the transmission of data brought about the establishment of many national and international networks.

However, such an upheaval in data handling did not occur without the posing of serious problems of a political, economic and social nature, even though it is generally recognized that the international transmission of data is useful for the operation of the world economy and furnishes developing countries the opportunity to exchange data and know-how, which are essential for their economic and social development.

"The transmission of data has become vital to international trade, finance and trips." The advantages offered by the transmission of data at the world level are unquestioned: meteorological forecasts, exploring and locating land resources, transfer of technology...

From the technological standpoint, data transmission networks in general include a data-handling complex characterized by input terminals, readers and other data input devices, a storage system (electromagnetic files, microfilms), an information handling system (domestic computer, microprocessors), a transfer process (telephones, optical fibers) and a distribution system; i.e., printout, television screen. It is understood that these systems are integrated and that different combinations permit production of videophones, videofiches and videodisks...

After discussion of the impact of data transmission, the participants in the Abidjan conference took up the legal and social implications, economic aspects, regulations, interdependence and international cooperation.

Let us recall that the conference agenda in fact is a forerunner of the world conference to be held next June in Rome.

Today's session will be basically devoted to communications. In fact, if the agenda is not changed, four talks will be given on the following topics, among others: micro-data processing, data processing networks, the new managerial style and, finally, the logical approach to new data processing techniques.

We will provide more detailed information on certain aspects of data processing.

Closing Session of Conference

Abidjan FRATERNITE-MATIN in French 30 Nov 79 p 8

[Article by S. O'Keilas]

[Text] The work of the conference for the integration of African data processing which began on 22 November in the meeting hall of the Hotel Ivoire will end this morning.

The closing ceremony, which will take place at 1130 hours after a plenary session devoted exclusively to debates and approval of recommendations, will be chaired by Grand Chancellor Coffi Gadeau, representative of the chief of state, in the presence of the minister of Economy, Finance and Planning, Abdoulaye Kone, head of the Ivory Coast delegation to this conference; the minister of Technical Education and Professional Training, Barry Battesti; and the minister of Posts and Telecommunications, Bangali Kone.

The director general of the IBI, Professor Bernasconi, will also be in attendance with these personalities. Let us recall that this United Nations organization is the cosponsor of the Abidjan conference with the OCM.

Before reviewing certain aspects of this conference and speeches given by experts in the field, we can even now say that the Abidjan conference attained its objectives. In fact, in addition to its impact, the recommendations to be adopted this morning are tangible proof thereof. The world conference in Rome in 1980 on the subject of the transnational flow of data has in large measure been primed by the conference which has just ended.

Moreover, the many papers presented which took up various aspects of data processing will enable each delegate to better brief the authorities of his country. Finally, the various contacts made during the conference are doubtless the beginnings of new and fruitful regional cooperation in the data processing sector.

With the Abidjan conference and the impressive participation of leading figures in the field, data processing is more than ever shown to be a means and not an end. That is, it is not enough to wish to computerize; the question is one of asking oneself what data processing can contribute to an organization. To repeat a remark by Professor Narnier, the computer will never think for man. Nevertheless, it has been proved that with the advent of micro-data processing and telemetry, the man of tomorrow will not be able to do without the use of data processing.

Highlights of Conference

Abidjan FRATERNITE-MATIN in French 1-2 Dec 79 p 8

[Article by Samba Kone]

[Text] The work of the conference for the integration of African data processing was concluded yesterday morning as scheduled in the meeting hall of the Hotel Ivoire. The closing ceremony was chaired by the grand chancellor, Germain Coffi Gadeau, representative of the chief of state, and was attended by Abdoulaye Kone, minister of Economy, Finance and Planning and many personalities.

The final report presented by the general reporter of the conference, head of the Gabonese delegation, Mr Ingangui, emphasized the great interest in the Abidjan conference and recalled the triple objective envisaged, namely on the one hand, with an eye on the world conference in Rome in 1980, to record the African group's point of view with respect to the question of transnational exchanges of data (the political, economic and socio-educational implications); and, on the other hand, to give a report on the perspectives opened by new data processing techniques to African data processing authorities; and, finally, to examine the bases on which data processing cooperation in Africa can be established and developed.

Thus, after having exhausted its agenda, the Abidjan conference formulated 20 recommendations. For each African, these recommendations range from the definition of a national policy in the data processing sector to the

immediate establishment of an organization for coordinating and planning the technical means of communications and transmission of data processing information, including, among others, every country's obtaining without cost the information concerning it being maintained in data banks used by these networks, access at minimal cost to data...

These recommendations reflect the desire of African countries to participate more actively in the collection, handling and distribution of their own data. Certain structures are already in place and should be developed. What is more, member states should be helped to establish coherent and usable national information networks and, of course, to envisage establishment of central data banks on national information networks permitting facilitation of exchanges between countries...

Paralleling the work of the committees, the delegates of the Abidjan conference listened to 15 reports on various aspects of data processing. In our next Monday edition (science-progress page) we will come back to certain points taken up by the experts.

In his speech during the closing ceremony, the director general of the IBI, Professor Bernasconi, praised the work done by the delegates in the past 8 days they spent together. He expressed his pleasure over the results obtained and emphasized in substance: "Our world is becoming smaller every day. Countries and men are closer every day. Under the circumstances, no one can ignore the rest of the world which is ever near at hand. That is why we find your recommendations well-founded, namely an appeal for regional cooperation, geographical groups to harmonize policies of infrastructure planning and undertaking jointly that which cannot be done within the framework of a single state."

Speaking next, the minister of Economy, Finance and Planning, Abdoulaye Kone, thanked the entire body of delegates for the results of the Abidjan conference.

Minister Abdoulaye Kone at length emphasized respect for the freedom of all parties in this new field, as it is true that new data processing techniques open many perspectives and no less temptations [tentatives].

"These initial general efforts in African data processing, Minister Abdoulaye Kone went on to say, "should be considered an essential stage in the long and difficult process which will lead our continent to be considered as a major partner in the organization of data processing at the world level."

In a related connection, a motion of appreciation presented by the delegate from the Republic of Zambia, Daniel P. Kapaya, was addressed to the Ivory Coast and His Excellency, the president of the republic, Felix Houphouet-Boigny.

In the afternoon, diplomas were handed out in the Balafon Room of the Hotel Ivoire by the minister of Technical Education and Professional Training, Ange-Barry Battesti, to 11 young programmers [concepteurs] who had completed training at the National Institute of Data Processing Management (INIG) (France). Many personalities from the Ivory Coast data processing world took part in this ceremony which was held in the presence of the director of the INIG and Professor Warnier.

IBI Head Comments on Conference

Abidjan FRATERNITE-MATIN in French 3 Dec 79 p 21

[Interview with Prof Firmin A. Bernasconi, director general of the Intergovernmental Bureau for Data Processing, by S. O'Kellas Kane, date not given]

[Text] [Question] Mr Director General of the Intergovernmental Bureau for Data Processing, the work of the Abidjan conference ended with the adoption of 20 recommendations. What are your impressions?

[Answer] The purpose of this conference was to stress African integration in the age of data processing with all aspects tied to transnational exchanges of data and the new perspectives of micro-data processing. There was active participation by most African countries.

[Question] Today Africa has every opportunity of getting aboard the train of the data processing revolution.

[Answer] This conference was a very emotional thing for all parties.

Contrary to what usually happens; i.e., a few practical recommendations and many of the declamatory kind, in Abidjan the accent was truly placed on specific and concrete things. That, in my opinion, shows the countries of Africa are ripe for the field of data processing.

I must add that the Ivory Coast authorities demonstrated an exceptional capacity for organization. And that made our task much easier.

[Question] IBI's participation in this conference was very active. Can you tell us what developing countries can expect from your organization?

[Answer] The job of the IBI is to orient itself toward developing countries. It is an intergovernmental organization established to help the developing countries in all that concerns data processing. Our activities are broken down into three sectors. On the one hand, we have problems of briefing the political cadres of countries. In fact, these are politicians who have the decision-making authority; and they must understand right now that data processing is not merely a technological problem but also a political problem with enormous socioeconomic fallout.

Everytime one feels that he has secured independence in one sector, he finds he has lost it in another; when one has had political independence, one has understood that he did not have economic independence. In acquiring economic independence what does one observe? That he is caught up in the machinery of technology. And now, if we are not careful, we will once again be dependent on everything that has to do with data processing. That is, the political authorities should attempt to define a data processing policy in their countries. Secondly, we intervene at the level of distributing everything possible in the data processing field. This involves helping the authorities to better implement the various applications and to better choose what is to be done. In a way, we are playing the role of technical assistance.

Finally, our activities fall within the framework of training and proficiency.

In these three sectors, the Intergovernmental Bureau for Data Processing can make a big contribution to developing countries and most particularly African countries.

[Question] During the Abidjan conference, there was much talk of new data processing techniques. And it seems that in the near future this will become an integral part of our lives. What impact will this have on developing countries?

[Answer] The first thought which comes to my mind is that developing countries will be the very ones to derive the most benefit from the new data processing techniques. In fact, up until the conference, the kind of data processing techniques being used were the classical data processing techniques conceived to solve the problems of the industrialized countries. These involved centralized data processing techniques not conceived for developing countries. However, they were forced to adopt our structures, our thinking, even our language for these instruments of development. One could say that they paid a rather high price for the benefits derived from data processing.

But new data processing techniques permit them to do just the opposite. That is, they permit the shaping of data processing to the characteristic needs and typical problems of each country. Now a tool is at the disposition of those who use it and not the other way around.

With micro-computers and micro-processors, new data processing techniques are being increasingly integrated into the life of the man in the street.

That is one additional reason for the political authorities of a country to be concerned. When something so profoundly affects man and society and could even change the structure of society and also makes possible its shaping at will, does that not spring from the sector of political decision?

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FRANCE

TELECOMMUNICATIONS-CRYPTOGRAPHY INTERRELATIONSHIP VIEWED

Paris LE MONDE in French 26 Dec 79 p 9

[Article by Xavier Weeger: "Cryptography News: When Secret Codes Become Public"]

[Text] Some people have always felt the need to shield information by secrecy. To this end, for centuries, governments and the military have utilized methods to dissimulate the contents of certain messages by secret codes. General staffs and governments, in their correspondence with their embassies, have availed themselves for a long time of the abilities of various cryptographic services.

Cryptography--the art of making a message unintelligible in principle to others than the receiver--has developed very rapidly between the two wars. It is often essential since at this time telecommunications have become one of the sinews of war, and the most strategic messages frequently travel by easily intercepted radio waves.

With the massive development of information science the need for secrecy tends to extend far beyond military circles or organizations handling "strategic" data in the strong sense of the word. The birth and rapid development of banking networks obviously require that financial information and financial transfer orders should travel secretly and unforged.

Therefore, in response to the demand, some computermanufacturers, including the first of them, IBM, have been suggesting for some time to their customers key-supplied cryptographic systems.

Correlatively, many applied mathematics researchers attempt to invent--some successfully as will be seen below--new cryptographic systems of wide application and practically unbreakable by persons called cryptoanalysts in the terminology of the art.

To code a message is quite simply to replace a character or a word according to a rule prearranged between the sender and the receiver. The simplest and most easily broken code is that utilized by all schoolboys, and consists

in correlating each of the letters of the alphabet with each of the letters of a translated alphabet, for example substituting H for A, I for B, J for C, etc.

Strangely, the only code which can be proved totally unbreakable can be derived directly from it. In this code each letter of the message is replaced in the ciphered message by the corresponding letter of a translated alphabet, but using a different translated alphabet for each of the letters of the message. For example a translated alphabet can be designated H if A becomes H (therefore B becomes I, C becomes J, etc.), K if A becomes K (B becomes L, etc.). Therefore any sequence of letters can be considered as a sequence of translated alphabets, i.e. a code.

For example, the first word of the preceding paragraph, strangely [French: "curieusement"] can be used as a code to encrypt "message." To code M the C alphabet (therefore A = C, B = D, etc.) is used, so that M becomes O. For the second letter to be coded, E, the second alphabet is used and designated in the code as alphabet U (A = U, B = V), so that E becomes Y. According to this code "message" becomes OYJAEAW. Admitting therefore that a code may consist of any sequence of letters, there is as much probability that the word is the result of the encryption of "amicale" (friendly), "betises" (blunders), or "chapeau" (hat) as of "message."

A pocket-size book is easily sufficient to code a considerable number of medium-length messages. For the key to be totally unbreakable, however, the succession of the translated alphabets must be almost totally random, but a written text usable as a code and in which some letters are more frequent than others does not conform to this rule. The difficulty is easily eliminated by replacing the letter code by a numerical code, assuming that each numeral designates an alphabet translation. The numerals can be easily randomized.

Great Disadvantages

These simple coding methods are still in extensive use especially in diplomatic circles. It is also a process of this type which is used to shield messages transmitted by the red-line telephone (actually a Telex line) connecting Washington to Moscow. These methods are still the most secure, provided of course that the code has not fallen into alien hands.

However, this cryptographic method entails great disadvantages, of which the length of the key to the code must be at least equal to the length of the message to be transmitted. The general use of substitution processes (substitution of one alphabet for another, or more generally today of a sequence of numbers for another) based on this simple method would soon prove totally useless for example in military operations, because it requires the processing of double the quantity of information.

Therefore, these secure, but bulky methods must be replaced by processes of more flexible use in ordinary applications. Generally, messages are exchanged between computers, and all modern cryptographic methods utilize numbers, using the decimal system (0, 1, ... 9) or the binary system (0 or 1).

Permutation and Substitution

Considering for example a word comprising five binary digits, permutation consists in changing the place of the five characters composing the word (for example 01100 provides 00101 with the permutation abcde-eacdb). In electronics, these permutations can be produced by suitable wiring.

In contrast, substitution consists in exchanging characters for others in a word, using a correspondence table. Again, in a binary operation (using only 0 and 1), for example, the first character is changed (0 becomes 1 or vice versa), the second is not changed, the third is changed, etc. Because of the properties of base-2 numbers this substitution operation is equivalent to a modulo-2 addition (1+0=1, 1+1=0), and for example the key 01101 means that the first and fourth characters are not modified, but the second, third, and fifth are transposed (1 becomes 0 and 0 becomes 1). For example 11010 becomes 10111, which is obtained by modulo-2 addition: 11010 (plaintext message) + 01101 (key) = 10111. In other words, to code a word it is sufficient to add the key to the word. To decode, the key is added again to the coded word to retrieve the original word: 10111+01101= 11010. Consequently, the substitution is simply an addition, which is an elementary operation in information science.

Actually, it is not sufficient to code successively words of a few characters (a few bits), since such a system would be highly vulnerable. A trick invented by IBM researchers consists in alternating substitutions in words of a few characters, and permutations in all the characters of several consecutive words.

In July 1977 the U.S. National Bureau of Standards published a cryptographic standard called Data Encryption System (DES) which is very closely derived from the work of the American deviser. In so-defined cryptographic systems now available commercially in the United States and in Europe, the key used is a word of 56 bits (0 or 1). Thus, there are 2^{56} possible different keys, i.e. more than 72 quadrillions.

The coding described in DES comprises 16 steps alternating substitutions based on the key (specifically, each substitution depends on 48 of the 56 bits of the key) and permutations predetermined once and for all.

Further to increase the strength of the system, instead of coding the words in succession, string coding may be used, in which the result of the coding of one word depends for example on the word itself and also on the result of the coding of the preceding word.

The addition of these arrangements strengthens the resistance of the system to external tampering. Were an unauthorized agent to attempt to alter a datum in a message the entire message would be polluted, and the machine would reject it.

According to the promoters, DES--whose use is to spread extensively in banking and commercial circles--is so secure that the most powerful computers of the world would have to operate for about 15 years to decipher a coded message. The method is relatively simple. As the algorithm (mathematical method) is public, it consists in trying successively all the keys.

There is, however, no general agreement. American researchers have accused IBM of accepting to limit the length of the key to 56 characters at the request of the National Security Agency (NSA) which is responsible for the protection of secrecy at Federal level. And, according to these researchers, NSA imposed this limitation so that it could itself break the secrecy barrier, but a U.S. Senate Committee specialized in these matters has rejected the accusations.

One of the accusers, Martin Hellman of Stanford University, may have a few reasons to produce such affirmations since he originated a totally novel concept called by him public cryptography, which may revolutionize cryptographic science.

The entire secrecy of a code lies in the secrecy of the key, especially when the method is public as in the DES case. This implies, for example in organizations containing many potential senders and receivers of secret messages, a very strict control of the keys and multilevel security, aside from the problems involved in transmitting a key from one point to another.

Hellman's idea consists in proposing a coding algorithm (mathematical method) of surprising a priori properties. To send a message to a person B, A would code the message with a public method, using a public key belonging to B and contained, for example, in a directory. Thus, anyone could code a message addressed to B, but only B could decipher it.

A few years ago such a one-way coding idea might have seemed absurd. Today such methods are conceivable because of the study of a family of problems called NP problems. In particular these problems present the property that it is very difficult to find the solutions of one of them, but when an idea of a solution has been found its correctness is established in a relatively short time.*

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* For a problem of this type the number of operations required to find the general solutions is proportional to an exponential of form 2n, the number of operations needed for a correct solution is proportional to a polynomial function of n such as n2. This second number increases at a much slower rate than the first.

Two public-key cryptosystems are now well know to specialists. The first, devised by Martin Hellman and his colleague Ralph Merkle is called the knapsack system.**

The RSA System

The second system which we are to describe briefly is the result of the work of three researchers of the Massachusetts Institute of Technology, Rivest, Shamir and Adleman. It is called RSA from the initials of its inventors. The RSA system is based on the general factoring of very large numbers into prime numbers.

Each user of the RSA system selects two large prime numbers p and q (there are computer programs used to generate such numbers). To send a message to one user, the other users will find in the directory the product n of these two numbers, which may contain for example 200 digits, and a randomly-selected number E. After converting their message to numerical digits--in this case to the decimal system--the resulting string of numbers is broken into blocks P_1, etc., and the senders compute

$$C_1=P_1^E \text{ modulo } n$$

(i.e. the remainder of the division by n of P_1 to the power E). The decoding of C_1 to recover P_1 is not a more difficult operation, provided that the factors p and q are known:

$$P_1=C^D \text{ modulo } n$$

with D such that:

$ED=1 \text{ modulo } (p-1)(q-1)$

(since p and q are primes this number exists). The secret deciphering key D cannot be computed if p and q are not known. And if n (=pq) is large, no method is available today to recover p and q from n, except by the mathematical test of all successive integers, which would require much time: According to Rivest, if p and q are written with 63 figures it would take about 40 quadrillions of years with the most powerful computers.

The RSA system also makes it possible for the message receiver to be sure that the sender is really the one he believes to be. The sender codes a signature with his secret key. Restoring it with the public key, the person knowing the secret key, the receiver knows that only the person knowing the

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** Readers interested in these public-key cryptosystems may refer in particular to Martin Gardner's "Mathematical Games" section in Scientific American, August 1977, and to an article "The Mathematics of Public-Key Cryptography", by Martin Hellman, in Pour La Science, October 1979. Some of the notations used here have been taken directly from this article.

secret key, the receiver knows that only the person knowing the secret key could have sent the message. This sender identification problem may be crucial, for example if the message in question is a bank transfer or order.

Obviously, these methods require the use of the computer, but not necessarily a large machine, far from it. The development of information data exchange, the progress of mathematics, and the growth of military needs certainly holds out a bright future for cryptography.

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INDIVIDUAL, COMMUNITY TV RECEPTION STATIONS COMPARED

Paris REVUE TECHNIQUE in French March 79 pp 159-187

[Article by R. Hagenbucher of Thomson-CSF's Radio Relay and Space Communications Division; manuscript received on 22 November 1978]

[Text] Direct television reception is emerging as a new milestone in the evolution which followed TV transmission by satellite from Syncom 1. After discussing its advantages and prospects, the author compares the two categories of reception stations generally being considered: individual stations and community stations--from the standpoint of performance, operating constraints, start of operational service, production on a quantity basis, and cost.

A number of possible schematics are compared, as well as three particularly important items of equipment: the antenna, the HF end, and the frequency demodulator.

I Introduction

Three levels may be distinguished in the development of television transmission by satellite and its redistribution.

First level: television communications by satellite are strictly international, or even intercontinental. They use a very small number of ground stations with high performances and of a large size (antenna diameter of about 30 meters; see figure 1). In general there is one transmission/reception station per country. From this one station, the routing and rebroadcasting of images within the country are done by the conventional infrastructure which already exists: radio relay systems, UHF or VHF retransmitters. At the present time, most television by satellite transmissions are handled in this way, which was first used in 1964

for the live retransmission of the Tokyo Olympic Games between Japan and the United STates by means of the experimental Syncom 3 satellite.

A second level has been developed with the appearance of domestic networks, designed to meet telecommunications needs within one country. The ground network then consists of a certain number of transmission-reception stations (antenna diameter of about 10-15 meters; see figure 2), which thus become regional stations serving a limited area.

This development began in 1972 with the launch of the Canadian satellite Anik-A-1, the focal point of a national network operated by Telesat, including about 40 stations equipped only for television reception, with antenna diameters between 4.5 and 8 meters, depending on their geographic position. These stations are unmanned.

Since 1976, the Indonesian national network built around the domestic satellite Palapa (closely related to Anik) has been another example of the same type. In 1975, Intelsat began to rent repeaters for domestic networks. Since then, a number of countries, such as Nigeria, Algeria, and soon Zaire, have made use of this service to acquire a satellite communications system.

The third level, which is still only in an experimental phase, entails a reduction in the dimensions and cost of stations to such an extent that they become accessible to the individual (in the case of individual reception) or to a community (community reception). Figure 3 shows such an experimental station; the antenna diameter is 1.5 meters.

This method, which is expected to progress significantly in the coming decade, is satellite broadcasting, either sound or video broadcasting. In the remainder of this paper, we will discuss only television broadcasting.

Two factors have combined to favor the development of direct broadcasting: the constant increase in the masses which can be placed in orbit, and the appearance of domestic satellites.

The following table illustrates the increased mass of the Intelsat communications satellites placed in earth-synchronous orbits.

Table 1

Satellite	Weight in Earth-synchronous orbit	Date of first launch
Intelsat 1 (Early Bird)	38.5	Apr 65
Intelsat 2	87	Jan 67
Intelsat 3	152	Dec 68
Intelsat 4	725	Jan 71
Intelsat 5	1,010	scheduled for 79

This increase in mass which can be placed in orbit enables the satellite to carry the high-power transmitters needed for direct broadcasting and the power supply equipment; depending on the size of the country to be covered, the SHF powers needed for a program range between approximately 100 and 500 W (there are plans to serve countries with a very large area, such as Canada, Brazil, etc., by using several antennas, so that the SHF power required can be limited).

Furthermore, direct television broadcasting by satellite is closely linked to the concept of a domestic network, or perhaps a regional network (serving a group of nations which are close both geographically and in their political-economic systems). For one reason, nations would like, for obvious reasons of national sovereignty, to remain in control of the TV programs received by their citizens; and for the second reason, coverage limited to one country makes it possible to transmit by using a high gain antenna carried on the satellite.

These two factors together permit reaching the very high satellite PIRE [Equivalent Isotropic Radiated Power] levels required for direct television reception. These high PIRE would have inevitably disrupted already existing ground or space services if they had not been allocated frequency bands that are either exclusive, or in which the direct broadcasting service is given priority. These bands were determined during the revision of the ITU's [International Telecommunications Union] Radiocommunications Regulation in 1971. Those which are most likely to be used in the foreseeable future are the following:

a. 11.7...12.5 GHz in region 1 (Europe, Africa), limited to 11.7...12.2 GHz in regions 2 and 3 (the rest of the world). This is certainly the band that will be used by the great majority of the satellites designed for direct TV broadcasting. For that reason, we will henceforth discuss only equipment operating at these frequencies.

b. 2.5...2.69 GHz.

c. 620...790 MHz. This has been authorized, with very severe restrictions, in order not to disrupt ground broadcasting services already using this band, at the insistence of India and the United States. The United States might, in the more or less long term period, have direct AM transmissions from heavy satellites transmitting several tens of kilowatts. No supplemental ground equipment would be needed to receive these transmissions.

The 3.7...4.2 GHz band, used by the domestic networks mentioned earlier, is absolutely unusable for direct broadcasting because of the limitations on the density of power flow imposed. In fact, this band is already being used along with fixed service satellite equipment, for many ground links served by radio relay systems.

II Interest and Prospects

The interest of satellite broadcasting is readily apparent in the case of the developing countries and in all countries with a very large area. Its interest appeared more recently in the European countries which already have conventional systems:

a. Reception is possible from amy place where the satellite is visible. This feature is of special interest for very large countries with a low population density. Also, we can add that even in countries like France, serving the last percentages of the population (living in mountains or on islands) takes a long time to implement and is relatively expensive, even if this service alone does not justify the use of a satellite.

b. Most often, the developing countries have only a very limited television broadcasting infrastructure which serves only a few large cities. In this case, a satellite broadcasting system can considerably reduce the time needed to achieve a total coverage. This gain in the time factor is especially appealing when the goal is to provide educational television service. This use is often considered the best justification for the satellite system in the developing countries (but on this topic, one may think that the development and use of effective educational programs will pose problems just as difiicult, if not more so, than those involved in the "direct broadcasting network" tool).

c. In countries which already have extensive systems, the interest to the user lies in the large increase in the number of programs from which he may choose (on the condition that the companies responsible for programming follow--or rather, precede). Moreover, the possibility of being able to receive, if he so desires, foreign programs in overlapping zones seems a not insignificant motivation.

d. Finally, the development of some supplemental services could be stimulated by direct reception: these services might include tele-message service, which consists of ordering the start and stop of a waiting magnetoscope by a coded signal at the start and end of transmission. Among other things, it is possible to use this type of service for transmitting and recording specific programs during the empty hours of the night.

III Definitions, Types of Stations

A satellite broadcasting service is one in which the signals transmitted (by the satellite) are designed to be received directly by the public in general. The term "received directly" applies both to individual and to community reception.

Individual reception is done by means of simple household equipment, involving facilities equipped with small antennas.

Community reception is done by reception facilities which may in some cases be complex and have larger antennas than those used for individual reception, and destined to be used:

a. By a group of the public in general in the same place.

b. Or by means of a distribution system serving a limited area.

These three definitions are used by the CCIR [International Telecommunications Advisory Board] (Report 471-1). When there is more interest in the ground sector, there is also frequent mention of the term "direct television reception," without any further clarification. That means both individual and community reception stations.

As we see, these definitions are essentially qualitative. The CAMR [World Administrative Conference on Radiocommunications] in February 1977 gave some quantitative descriptions for the 12 GHz band. In summary, we can say that direct TV reception at 12 GHz involves:

a. Strictly reception stations. Mixed "television reception and some telephone channels stations" are excluded. This mode of operation imposes severe technical constraints (stability of reception local oscillators, transmitter, bandwidth of the receiver, for the telephone system should not use the band reserved for satellite broadcasting). Because of these constraints, this equipment is not usually designed for general public use.

b. Stations equipped with antennas of a diameter under 1.8 m. This is the maximum that can be easily installed on building roofs.

c. Stations which receive signals in the satellite broadcasting band: 11.7...12.5 GHz for region 1 and 11.7...12.2 GHz for regions 2 and 3.

d. Stations designed to be manufactured on a medium scale (community station) or on a large-scale basis (individual station).

The CAMR of 1977 established a "plan" valid for regions 1 and 3. For each country this plan establishes:

a. The position of the corresponding satellite in an earth-synchronous orbit.

b. The PIRE transmitted.

c. The long axis and the short axis of the coverage ellipse.

d. The polarization to be used.

e. The frequencies allocated to this country--in most cases, five frequencies. The 800 MHz band allocated to region 1 is divided into 40 equidistant channels, each being reused about 25 times (as the interval between two channels = 19.18 MHz, the gap between two frequencies for the same country is 76.72 MHz).

Table 2 lists the channels assigned to the European countries.

Table 2

Country	Channels					Polarization	Satellite Position
France	1	5	9	13	17	1	19°W
Germany	2	6	10	14	18	2	19°W
Belgium	21	25	29	33	37	1	19°W
England	4	8	12	16	20	1	31°W
Italy	24	28	32	36	40	2	19°W
Spain	23	27	32	36	40	2	31°W
Switzerland	22	26	30	35	38	2	19°W
Holland	23	27	31	35	39	1	19°W
Luxembourg	3	7	11	15	19	1	19°W

1 means direct polarization or "dextrogyre."
2 means indirect polarization or "levogyre."

Planning is based on two principles:

a. The principle of national coverage. As we saw earlier, this is justified both for technical and for legal and political reasons.

b. The principle of individual reception. In particular, the minimum spacing of satellites (6° of geostationary arc), the selection of frequencies; the jamming levels were deliberately selected in order to allow reception by low performance, inexpensive stations for mass distribution. This choice obviously will not prevent stations from beginning with a community reception system, but the planning is not invalidated by a later switch to individual reception.

A certain number of other technical parameters were used by the CCIR in developing the plan. They concern both the space sector (diagrams of satellite antennas for example) and characteristics of the ground stations. The most important are given in table 3.

Table 3

Parameters	Individual reception	Community reception
Type of modulation	FM	
Sound	Transmitted on sub-carrier	
Ground station G/T	6 dB/K	14 dB/K
Angle of aperture of ground antennas at half power	2°	1°
Diameters of corresponding antennas	0.9 m	1.8 m
C/N for 99 percent of time	14 dB	
Band per channel	27 MHz	
Energy dispersion	600 kHz cc	
Surface power on the ground	$-103\ dBW/m^2$	$-111\ dBW/m^2$

These specific figures are not to be used as recommendations, particularly those for the characteristics of the reception stations. However, it is true that they will be used as a reference for a good number of agencies which will have to evaluate equipment being offered to them.

In the years to come, two categories of stations are going to make their appearance on the market. We must be able to recognize the specific characteristics of these categories, so that the development and industrial production of this equipment may be handled in the best way possible.

IV Comparison between Individual and Community Stations

The terms "individual" and "community" that are normally used to describe the two types of direct reception stations are somewhat ambiguous. In fact, these two types are distinguished both by their reception performances and by their community or individual operation.

As the reception performances are of course determined by the satellite used, we should find on the world market stations corresponding roughly to the combinations listed in table 4. Only the two combinations underlined correspond to clearly defined stations.

Table 4

Operation \ Satellite PIRE	Strong ($\emptyset$ on the ground -103 dBW/m^2)	Weak ($\emptyset$ on the ground -111 dBW/m^2)
Individual	<u>Individual Station</u>	
Collective	Collective station	<u>Community Station</u>

While it is reasonable not to be interested in the "weak PIRE/individual operation" combination (these stations will be too expensive for an isolated individual), on the contrary, the "strong PIRE/collective operation" will certainly be frequently found. In order to avoid all confusion, we will call this type of station a "collective station." In its technology and its reception performances, it is close to an individual station. It is distinguished from the individual station only by its ability to serve several users independently. These users may be the members of the same family with several television sets, or the inhabitants of one building.

For that reason in the following, except when specifically stated to the contrary, everything said about individual stations is also applicable to collective stations.

Therefore, the community station will be distinguished from an individual station:

a. From the point of view of the period of their operational implementation;

b. Industrially;

c. And by their cost, an aspect which goes beyond the scope of this article.

This is in addition to their reception performances, and their mode of operation, which have already been mentioned.

Table 5 sums up these points of comparison.

Table 5: Comparison between individual and community stations.

Reception Sensitivity	Operating Constraints	Date of Start of Operational Service	Industrial Production
Individual station			
G/T = 6 dB/K	Generally, reception of 1 program among N. If simultaneous reception of several programs: "collective" station. Service important.	1985?	Large-scale production General public French market: 3 to 4×10^6 units
Community station			
G/T = 14 dB/K	Simultaneous reception of N programs. Reliability, availability important.	1983?	Small-scale production Professional equipment. French market: 3 to 4×10^5 units

4.1. Reception Sensitivity

A community station will be expected to have better reception sensitivity than an individual station for two reasons:

a. The first is that, as a general rule, a community station will be associated with a distribution network which will inevitably cause a deterioration of the signal when it reaches the user. (This is also true for a "collective" station).

b. The second, and more important reason is due to the fact that the satellite PIRE considered for a community reception service is weaker than for individual reception service, as is shown from the surface density values on the edge of the zone of coverage in table 3.

In examining these values, we could mention that a possible deterioration due to distribution was not included; but in fact, the difference of 8 dB between the surface densities on the ground for community reception (-111 dBW/m^2) and individual reception (-103 dBW/m^2) is exactly compensated by the difference in G/T.

However, these surface density values are minimum values, and nothing prevents them from being raised if necessary. In fact, there is no limitation on ground flux density in the 11.7... 12.5 GHz band; the only constraint is not to disturb any nearby signal.

4.2. Mode of Operation

A community (or collective) station has to be equipped so that each of the users that it serves may choose to receive any one of the N programs broadcast by the satellite. This constraint implies that there must be as many narrow-band channels as there are channels to receive. On leaving the station, there will therefore be N image access and N sound access; these two outputs are, in one way or another, linked to each user.

Starting there, the problem becomes a problem of teledistribution. At least two cable distribution procedures may be considered, for which we can foresee the modalities of use: distribution directly via video and audio frequencies, or distribution of VHF or UHF carriers in amplitude following ground television standards. These are illustrated in figures 7a and 7b.

The first procedure calls for a network of 2 N x M cables, if we want to distribute N programs to M users. Moreover, each user must have a program selector, in addition to a television set equipped with video and sound inputs.

If M is small, or if there is only one program to be distributed, this procedure may be of interest for it saves on the number of remodulators. However, if M is large, the number of cables becomes prohibitive. In this case it is better to use the second procedure. As a single coaxial cable can carry all these carriers simultaneously, the network will be reduced to one cable per user, or M cables. The selection of the program will be made by the television channel selector, and the only accessory will be a Yagi cable switch.

To the latter mode of distribution we should add retransmission by radio using standard low-power retransmitters. It seems probable that this procedure will often be the best for serving limited areas (hamlet, village) in developing countries. It will be more difficult to use in industrialized countries, because of the crowding of the bands allocated for ground broadcasting.

An individual station has to be designed so that its user may be able to choose any one of the N programs which can be received. So there is only one output linked to the television set. However, there must be a tuning device in the station.

Concerning the station-television set link, there is in principle no problem with this being done in video + audio, on the condition that the television set is equipped with the corresponding connections which will become standard equipment in the years to come.

The direct reception station must remain in service and be reliable. Higher reliability, or at least, a higher rate of availability, will be required of a community station than of an individual station. This requirement will be accompanied by certain additional precautions, such as the distribution of some components, and possibly alarms so that defective equipment can be located quickly. In the case of stations serving a large number of users, it may even be necessary to build in redundancy in equipment shared by a number of users.

Concerning individual reception stations, built and installed on a very large scale, one spin-off of their reliability will be the magnitude of the after-sale service system that will have to be established. That is a problem which will certainly become very important when retailers have to be trained in hyperfrequency technology.

4.3. Operational Implementation of Direct Reception Stations

While we can say that direct television reception has a promising future ahead, it would be foolhardly to try to predict the time when it will be truly operational. However, there are already experimental systems, and operational systems will undoubtedly be ready before 1985.

Table 6 below lists a number of satellites, either in existence now or planned, adapted for community or individual reception at 12 GHz.

Table 6: Existing or planned broadcasting satellites

Satellite	Type of reception possible	Launch date (scheduled)	Remarks
CTS (Canadian)	community	1976	
BSE (Japanese)	community	1978	
Anik-B (Canadian)	community	(1978)	community reception top of
Anik-C (Canadian)	community	(1980)	G/T = 20 dB/K line
European satellites	individual community	(1984)	
Zoheret (Iranian)	community	(1983)	

Other countries, including Argentina, Australia, Chile, and China, have expressed the desire to acquire satellites for direct broadcasting at 12 GHZ in the more or less long term.

It seems likely that in the first phase, most of the satellites launched will be adapted for community reception and not for individual reception. For, as the cost of a community station is shared among several users, the reception performances, and in particular the G/T may be significantly better than for an individual station. It is of no use for this G/T improvement to be brought to bear solely on the signal/noise video quality, which is already supposed to be very good in normal conditions for individual reception. It permits either the use in a given area of less powerful satellites than for an individual reception service, or the coverage of a larger area, including several countries.

In these two cases, the time required for development may be shortened, for the financial burden per country and the technical difficulty are both diminished.

4.4. Industrial Development

In order for the satellite broadcasting system to be operational, the mass production capacity of ground stations must be responsive to demand. By analogy with the development of demand for color television, it seems probable that originally it will remain modest, and that its growth will become rapid when the number of programs offered increases. Based on France, we can try to advance some figures.

The housing stock in France is divided half in individual housing units and half in collective housing units. In other words, one household in two lives in an individual house, the other lives in an apartment building. As there are 12 to 15 million households, the market for individual stations will be saturated with a supply of 6 to 7 million installations. Let us further assume that one building contains an average of 20 apartments. At the rate of one community station per building, the market will be saturated with 300,000 to 400,000 installations.

In reality, a weighting coefficient has to be applied to the number of individual stations, to include the fact that there will always be households which will not get the equipment; if we assume this to be equal to 0.5, the market will be saturated at 3 to 4 million individual installations.

We should also weight the number of stations (community or collective) for, in some cases, distribution may be done by a low-power retransmission of programs received to serve a limited area, in which the number of users may be much greater than 20. However, as we said earlier, it is likely that this mode of distribution will remain an exception in the industrialized countries, but it may be much more widely used in the developing nations.

We thus get a ratio of 10 between the number of individual stations and community stations. Of course, this ratio should also be true of the annual production of these stations.

These figures only have value as indications. But they do suggest that the individual station will quickly become a "mass public" product, while the community station, because of its more limited production, will keep a professional or more restricted nature.

V Formation of Individual and Community Reception Stations

Physically, there will always be the following functional units:

a. a small, fixed parabolic antenna, naturally without any tracking capability.

b. low noise 12 GHz reception equipment followed immediately by IF transposition equipment (first IF if it is a dual transposition schematic). The unit, attached to the antenna, will now be called the "SHF head."

c. a link connecting the SHF head to the interface equipment placed inside a protected area.

d. the interface equipment which, as a general rule, restores one or more complete programs (that is, the video and its corresponding sound). In the case of individual reception, this equipment is directly linked to the television set it serves by a very short cable link. It is the starting point for redistribution (or possibly rebroadcasting) in the case of community reception.

Many solutions are possible for the development of each of these functions. They depend on the type of station, individual or community, the performances required of the equipment (for example: capability or no capability of receiving a certain number of foreign programs in addition to national programs), the type of schematic used: single or dual transposition, tunable equipment...

5.1. Theoretical Schematics

A large number of schematics can be imagined, some of which are shown in figures 4 to 7: schematics 4 to 6 are for individual stations, schematics 7a and 7b are for community stations.

They are distinguished essentially by the number of changes in frequency and by the program selection procedure.

Figure 4 shows a standard schematic, the one most frequently found in the literature; it is a dual transposition system, with the entire reception band of 500 MHz (possibly 800 MHz) transposed at about 1 GHz (typical value of IF: 0.9...1.4 GHz).

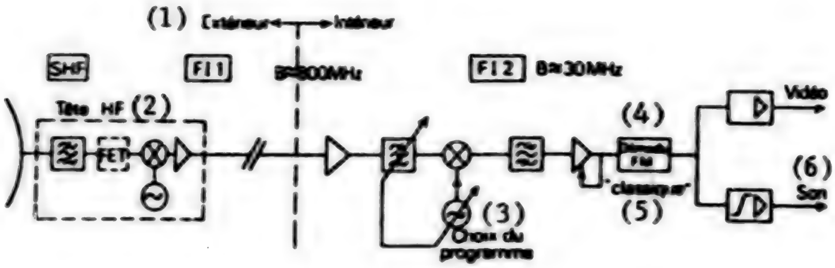

Figure 4. Individual station. Dual frequency change schematic.

Key:

1. External ⟷ internal
2. HF head
3. Program selection
4. FM demodulator
5. "standard"
6. Sound

Program selection within this band is done by tuning the local oscillator of the last frequency change after which filtering and demodulation are done. A tunable filter before the second mixer coupled with the local oscillator may be found necessary, depending on the value of the second IF to filter the image band. The circuits in the base band include essentially de-accentuation and the video and audio circuits (filters, energy dispersion signal suppression, demodulator, sound subcarrier...) and lead to two output access points.

Advantages of this schematic:

a. It entails few technical risks; most of the equipment already exists in either professional or mass public types of equipment, or may be directly derived from existing equipment.

b. The second IF is constant, no matter what program is selected. There is no equipment specific to the frequency received, and consequently, there is only a single station model to be manufactured, no matter to what country it is being sent.

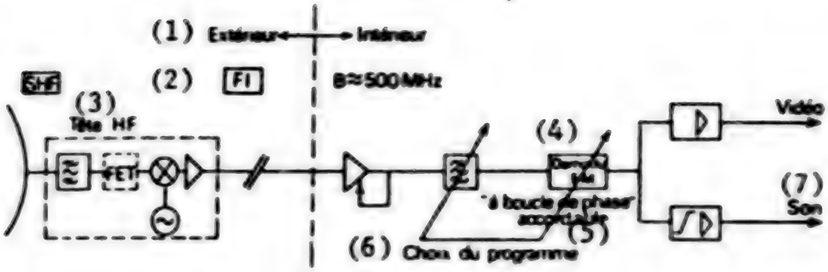

Figure 5. Individual station. Schematic showing single frequency change, tunable demodulator, with threshold improvement.

Key:

1. External ⟷ internal
2. IF
3. HF head
4. FM demodulator
5. "tunable phase loop"
6. Program selection
7. Sound

Disadvantages:

a. A larger number of equipment than in the following schematics, so its large-scale production cost will probably be higher and its reliability less.

Figure 5's schematic is a single transposition system. The SHF head and the IF band may be identical to those of the dual transposition schematic. Program selection is done by tuning the demodulator in this band, as well as the filter which precedes it; the purpose of this filter in this case is to limit the power of the carriers and the noise reaching the demodulator input.

Advantages:

a. The number of pieces of equipment is reduced; this decreases the cost of large-scale production and improves reliability.

b. The demodulator works at a high input frequency, a minimum of 1 GHz, which facilitates development of a "phase loop" demodulator. This type of demodulator does have a number of advantages, which will be discussed later.

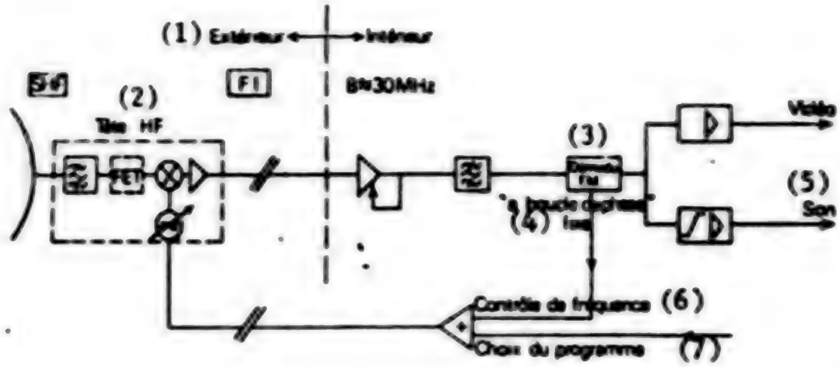

Figure 6. Individual station. Single frequency change, local oscillator frequency tunable. Fixed demodulator, with threshold improvement.

Key:

1. External ⟵⟶ internal
2. HF head
3. FM demodulator
4. "fixed phase loop"
5. Sound
6. Frequency control
7. Program selection

Disadvantages:

The main disadvantage lies essentially in the technical unknowns involved in the tunable phase loop demodulator in a 500 MHz band. A feasibility study is now in progress at the Radio Relay Division.

The schematic shown in figure 6 is also a single transposition system. The tunable element here is the hyperfrequency local oscillator (placed under the antenna) which is a VCO controled by a continuous voltage generated in the demodulator and depending on the distance between the frequency received and the nominal frequency. This voltage acts on the LO frequency to cancel out this difference. Program selection is done by a shift of the LO frequency by means of a continuous command voltage superimposed on the control voltage.

The essential advantage of this schematic is of course that the intermediate frequency remains constant no matter what the position of the signal in the SHF reception band; the selectivity filter and the demodulator are thus centered permanently on a fixed frequency.

One criticism made of this schematic is that it can be used to receive only a single program at a time; there is no possibility of extending it to several programs. Such a situation can not satisfy users with several television sets who might want to receive several programs at the same time. If we assume that eventually the majority of households will have at least two television sets, this is a real disadvantage, and one which warrants dropping this schematic from further consideration.

Community stations may also use single or dual frequency change schematics; in both cases, a wide band dispatcher provides as many outputs as programs which can be received at the same time, with each output supplying a complete IF (or first IF) image and sound output channel.

Figure 7 shows a single frequency change schematic in two variants with distribution of N programs to the user. Figure 7a represents a VHF (or UHF) distribution, after amplitude remodulation of the composite video plus sound subcarrier signal[1] (itself frequency modulated by the audio signal). Figure 7b represents the same schematic for reception itself; in contrast, one video output and one audio output per program are available. Distribution may be done by cables directly to television sets equipped with the appropriate inputs. The "base band" circuits of the station are definitely more complex than in the preceding schematic, requiring the following: an image/sound subcarrier separator, a sound demodulator, possibly a propagation time corrector for the video filter group, and amplifiers which can reach normalized output levels.

Thomson-CSF, using this schematic, designed and developed a community station equipped for N = 3 channels, in which the two modes of distribution given above were tested.

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1. It is possible to use only a single amplitude modulator, without having to make a separation of the image and sound for separate remodulation, if the [illegible] subcarrier was positioned and modulated at the time [illegible] transmission from the central station in order to be compatible with the TV standard used. This method is especially attractive when the TV sound is frequency modulated.

5.2. Principal Pieces of Equipment

A certain number of pieces of equipment forming a station, whether community or individual, are of a new type, considered from the point of view of a large-scale production. These items are essentially the hyperfrequency equipment: antenna and low-noise receiver, and the wide band frequency demodulator. In principle, the other equipment is more conventional and generally has a counterpart in either television or radio receivers.

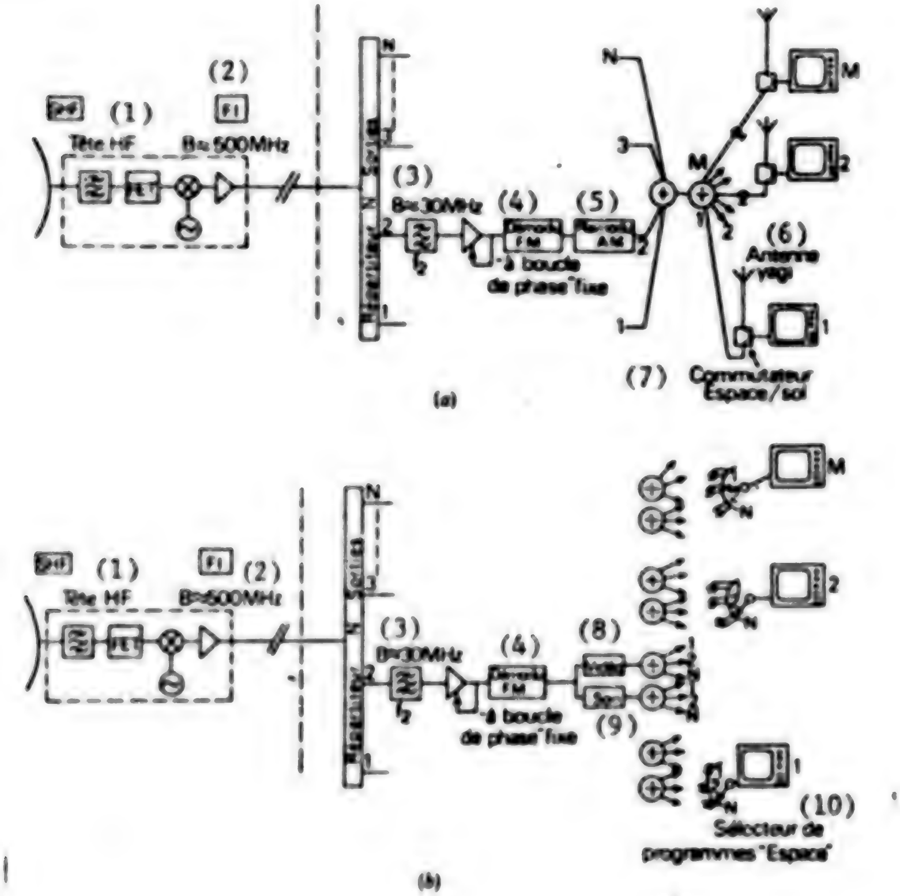

Figure 7. (a) Community station, single frequency change schematic. VHF distribution of N programs to M users.
(b) Community station, single frequency change schematic. Video + audio distribution of N programs to M users.

Key:

1. HF head
2. IF (Intermediate Frequency)
3. Distributor N outputs
4. Fixed "phase loop" FM demodulator
5. AM remodulator
6. Yagi antenna
7. Space/ground switcher
8. Video
9. Sound
10. "space" program selector

5.2.1. Antenna

The minimum antenna diameters depend on the maximum angle of aperture of the beams that can be tolerated. For if it is in one sense an advantage to have as wide an angle as possible from the point of view of ease of installation and satellite stability that it makes possible, this angle must also be limited, for the occupation of the orbit (angular spacing of satellites) is directly dependent on this angle: for a given jam level, the spacing between satellites is higher when the angle of aperture is wider (and consequently the gain is lower).

Another important characteristic of the antennas is the level of their secondary lobes. These form an input gate in the receiver for disruptive signals transmitted either by another satellite (even very far in angular distance from the axis of the antenna) or possibly by ground transmitters.

The "plan" established by the CAMR is based on the following features:

a. Angle of aperture with half-power φ_o:
Individual reception: 2° in regions 1 and 3, 1.8° in region 2;
Community reception: 1° in all regions.

b. Minimum spacing between two nominal orbital positions: 6°;

c. Secondary lobes, using the gauge shown in figure 8.

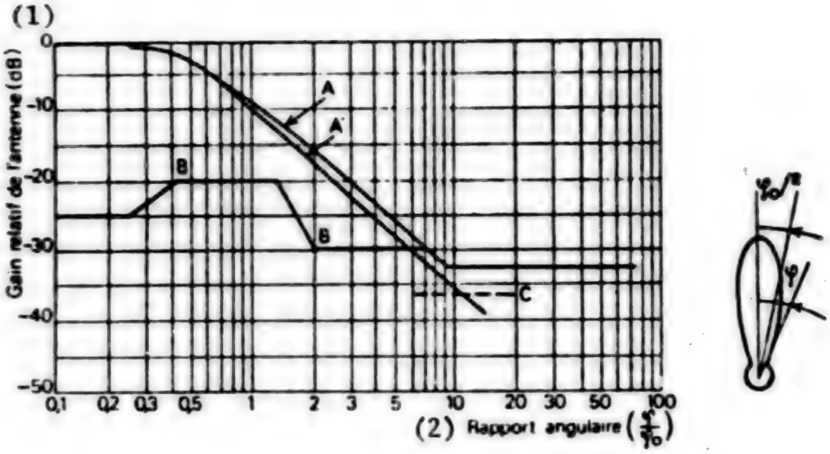

Figure 8. Reference diagrams for antennas of direct curve reception stations. A, individual reception station; A', community reception station; B, contrapolar component for both types of reception.

Key:

1. Relative antenna gain (dB)
2. Angular ratio

Insofar as individual reception is concerned, the value of 2° used for the angle of aperture of the antenna is a maximum value (in fact, an angle of aperture greater than 2° would require a minimum spacing between satellites greater than 6°, which would disrupt the entire plan). So this corresponds to a minimum reflector diameter of about 90 cm, which is that of the antenna shown in figure 9 (we also see the case containing the HF head).

From this comment, we can deduce the following consequences: a reduction of the noise temperature T of the system, by an improvement in the noise factor of the receiver, is of interest only if we want to improve the G/T of the station (either for a better reception quality, or primarily to permit a reduction in the satellite transmission power); generally speaking, it can not be expressed by a reduction in gain and consequently in the diameter of the antenna with G/T constant, since then the angle of aperture of the beam would exceed 2°.

In other words, any improvement in the noise factor of the individual station beyond a value so that a G/T of 6 dB/K is reached in association with an antenna 90 cm in diameter

does not necessarily tend toward reducing the cost of this station; it rather tends toward the optimization of the satellite + ground stations system.

For community reception, the figure of 1° seems to be a working value close to the minimum that may be possible; the diameter of its corresponding reflector is close to 1.8 m. It is normally believed that it will hardly be possible to exceed this diameter for operational reasons (difficulty of aiming the antenna because of the narrow beam; weight of the unit; increased influence of the instability of the satellite's position on the effective gain of the antenna as the angle of aperture decreases).

In radioelectricity, the two most frequently considered options now are the "Cassegrain" antenna and primarily the "focal source" antenna. Concerning the latter, opinions are divided about the location of the low-noise receiver, either directly on the power supply, or behind the reflector connecting it to the power supply by a "swan neck" wave guide.

The advantage of the first option is that it minimizes insertion losses and thus achieves the best possible G/T, the second greatly facilitates problems of attachment and protection against water, humidity, and heat. Moreover, the masking effect is reduced to a minimum.

In practice, both technologies are well suited for large-scale production. Dished plate and metalized reinforced plastic resin are used in the antennas shown in figures 3 and 9.

5.2.2. Antenna Equipment

No matter what option is selected, there will always be, attached to the antenna, a low-noise receiver in the 12 GHz band, which may use either an FET (Field Effect Transistor) preamplifier, or a direct mixer. In both cases, passage from the antenna toward the protected area is done at the intermediate frequency by a coaxial cable. The antenna equipment also includes transposition circuits, a local oscillator, a mixer, and preamplifier.

It is likely that the two types of low-noise receivers will be on the market at the same time. Thomson-CSF's Radio Relay and Space Communications Division has developed a direct mixer whose technology, which is under a Japanese patent, is very

well suited for large-scale, low-cost production. The hyper circuit unit is an etched metal plate, to which the SHF components are attached: mixing diode, possibly a local oscillator multiplying diode. This plate is placed inside a wave guide which leads only to the etched areas; these act as filter cavities. Everywhere else, the guide is in an evanescent mode. The metal plate may be replaced by a metalized dielectric plate; the etching is then produced by chemical attack of the metalized surface.

This technology significantly reduces tolerance problems; moreover, it uses only inexpensive, conventional components.

The models now developed (see figure 10) present a total noise factor of less than 6 dB in a 500 MHz band (typical value 5.5 dB) in the presence of an IF preamplifier with a noise factor of F = 2.2 dB in the 0.9...1.4 GHz band. The latter value may be definitely improved, which will thereby improve the overall noise factor by that amount.

The other solution, the FET 12 GHz amplifier (figure 11) is becoming more and more credible. For some years, progress has been rapid, performances have been considerably improved, and we can find FET preamplifiers with a noise temperature of 350°K (F = 3.5 dB). Forecasts for 1982-1983 predict a major decrease in the cost of FET transistors in general because, among other reasons, of the development of high-power FET, from which the low-noise FET will benefit.

This solution also encourages us to consider an "all FET" solution in which both the local oscillator and the mixer use FET transistors; a sophisticated integration of the entire SHF receiver then becomes possible, facilitating mass production. We can also mention the conversion gain that the FET mixer makes possible.

The antenna equipment is subject to environmental constraints which may be quite harsh. In temperate climates, the environmental temperatures range from -10°C to +40°C and more in the mountains or in the Mediterranean countries. Because of this environment, the local oscillator causes some special problems. It has to be compensated in temperature in order to limit the output frequency drift; this drift must not let the signal leave the usable band of the channel filter, which must therefore be enlarged.

The maximum drift value in relation to the nominal frequency which can be tolerated is about 5 MHz, which is a relative stability of 4.5×10^{-4} for an oscillator at 11 GHz. The most frequently considered types of oscillators now are:

a. GUNN diode oscillator at 11 GHz;

b. Bipolar transistor oscillator at about 3 GHz followed by a multiplier;

c. FET oscillator, oscillating directly at 11 GHz.

The frequency stabilization in temperature can be done by a guide cavity at 11 GHz compensated in temperature by a dielectric chip with a negative temperature coefficient.

Another solution, which seems promising, is to stabilize the oscillator by using a dielectric cavity of barium titanate $Ba_2(TiO_2)_0$ with a very high dielectric coefficient ($\varepsilon \approx 600^2$ at 3 GHz), and whose temperature coefficient is practically zero. The resonance frequency depends at first only on the characteristics of the dielectric cavity itself, so long as the coupling to the active element is weak.

In the end, it is not easy to favor one solution over another. It is more than probable that several types of receivers will coexist on the market even if, in the long run, the FET transistors do win the field.

In paragraph 5.2.1, we saw that a reduction in noise temperature was not necessarily justified for individual stations. So these could without disadvantage be equipped with inexpensive direct mixers, which easily provide a noise factor of about 6 dB, which is fully sufficient to meet the specification G/T = 6 dB/K of the CCIR (Note 1). But the community station receivers must have a noise factor under 5 dB to meet G/T = 14 dB/K (Note 2). The FET preamplifiers are then indicated for this equipment.

For individual stations, in the longer term there is still a third option. This consists of studying an FET transistor receiver with an overall noise factor of about 6 dB, an average level, but whose principal objective would be to be very inexpensive and suitable for large-scale production. This option leaves the door open to a later decrease in the noise factor, as the cheaper FET's performances are improved, which will authorize a gradual decrease in the PIRE transmitted by the satellites.

Note 1: A station equipped with an antenna 0.9 meter in diameter, with an illumination efficiency of 0.55 and a receiver with an overall noise factor of 6 dB at 12 GHz gives a G/T of 8.2 dB/K in good weather and in the antenna axis, based on a loss of 0.5 dB between the antenna and the receiver (signal filter, guide length...).

A margin of over 2 dB is thus available to compensate for an initial aim error, the effects of aging, and the wind. This is the figure used by the CCIR in its communications calculations.

Note 2: In the same conditions as stated above, a station equipped with a 1.8 m antenna and a receiver with a noise factor of F = 4.5 dB gives a G/T of 16.1 dB/K, which also leaves a margin of 2 dB to compensate for the various types of aim difficulties.

5.2.3. Demodulation Equipment

The schematics of figures 4, 7a, and 5 show three types of frequency demodulators:

a. A conventional discriminator with an input frequency set at 70 MHz, for example.

b. An improved threshold, phase loop demodulator, whose fixed input frequency is about 1 GHz.

c. An improved threshold demodulator of the same type as the preceding, but which can be tuned in a fairly broad frequency band.

The first type, used in the individual station represented in figure 4, is used in earth stations now in operation; it therefore presents no technical risks and keeps the studies needed to a minimum.

However, the input frequency of 70 MHz, the normal value of the intermediate frequency, in practical terms calls for a dual transposition schematic. In fact, based on the frequency band to be received (500 or 800 MHz), it is necessary to filter the image frequency by using a tunable filter coupled with the channel selector. It is hard to imagine an inexpensive development of such a filter at 12 GHz, as is required by a single transposition schematic. However, in a dual transposition schematic, this tunable filter is in the band of the first intermediate frequency, at about 1 GHz, and may be close to the "mass public" filters that are found in commercial television sets.

The schematic given in figure 7a includes an improved threshold phase loop demodulator. A recent article in REVUE TECHNIQUE (5) discusses this equipment in detail. So here we will just mention its main features:

a. Lowering of the reception threshold. For low values of the HF C/N signal to noise ratio, under 10 dB, the gain produced by this demodulator in relation to a conventional demodulator is about 2 dB. In other words, for the same video signal to noise ratio, the C/N ratio is 2 dB weaker with the demodulator with threshold extension.

b. The demodulated signal is not affected by amplitude noise in the HF signal received. So it is not necessary to use a limiter in front of the demodulator.

c. The filtering function is an integral part of the demodulator, since it is inserted in the phase loop. Therefore, we can reduce the requirements for the channel filter above the demodulator, whose only role is to limit the total power of the signals at input.

d. The schematic used is simpler than in a conventional limiter-discriminator schematic.

The advantage of lowering the threshold depends both on the broadcasting service's specifications, expressed in output quality as a function of percentage of time, and also on the amount of rainfall. If the most restrictive constraint is imposed by quality during a small percentage of time, corresponding to a C/N definitely less than 10 dB, the advantage produced by lowering the threshold is expressed by a decrease of the satellite PIRE needed, or of the station's G/T. In the opposite case, the advantage lies simply in the greater proportion of time during which there is an acceptable image.

We can point out another advantage of the improved threshold demodulator: since it can be used to receive weaker signals, it will be possible to receive programs intended for a nearby country over a larger area than with a conventional demodulator.

This type of demodulator is well suited to a single transposition community station with several reception channels, with each demodulator tuned to a particular channel. However, it is not well suited for an individual station, since program selection must be done by tuning the SHF local oscillator of the antenna equipment.

That is why the third type of demodulator used in the individual station of figure 5 is now under study. Like the preceding demodulator, it has a threshold extension, but it can be tuned to the entire reception band. With this demodulator, it is possible to design a single transposition schematic for an individual station.

VI Conclusions

Once the process has begun, the market for individual, collective, and community stations will become quite large. Some countries, particularly those in which television broadcasting is a monopoly, will prefer a network using individual stations (or collective in the previously defined meaning of the term) to avoid any discrimination between users. In other countries, which have privately operated channels, several networks of the community or individual type may coexist.

In the developing countries, there is a good chance that the first networks to be developed will be of the community type. First of all, the satellite needed is less expensive, and secondly, the purchasing power is too low to give rise to any real market for individual stations. We may expect that in the majority of cases, the stations will be bought and operated by a government agency.

The operational implementation of direct satellite broadcasting networks will certainly become a reality in the years between 1985 to 1990. This will represent progress in the industrialized countries which already have a major conventional infrastructure, for it will permit a rapid increase in the number of national programs broadcast, and the reception, with some limits, of foreign programs.

In the developing countries, such networks may become a very important factor for progress, if they are well used.

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